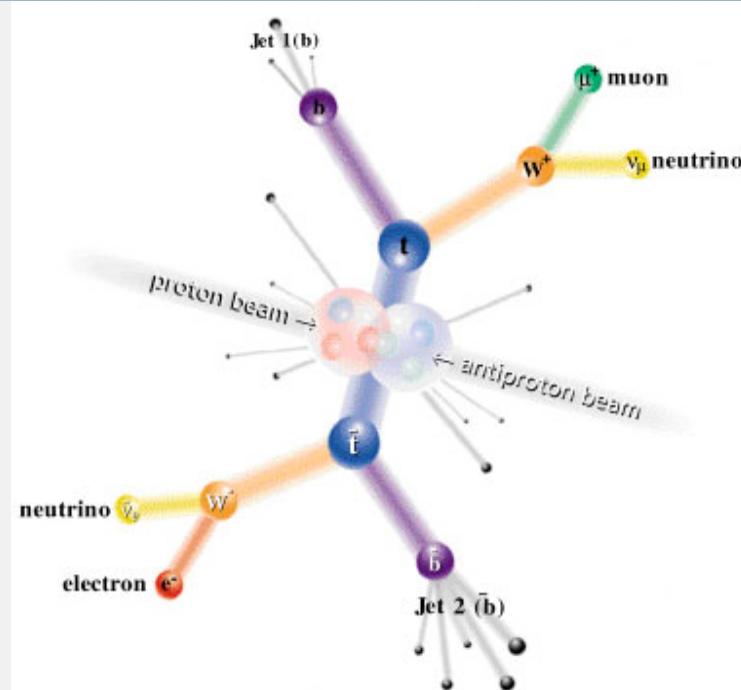


TOP PAIR PRODUCTION MEASUREMENTS

AT $S^{1/2} = 2 \text{ TeV}$



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October 27, 2005

10/27/05

Bob Kehoe - SMU

- the newest quark

- WHAT ARE MODES OF PRODUCTION AND DECAY?
- WHAT ARE THE FINAL STATE KINEMATICS?
- IS IT REALLY A LA ELECTROWEAK THEORY?

- a very large mass...

...and a suspicious Yukawa coupling ~ 1 !

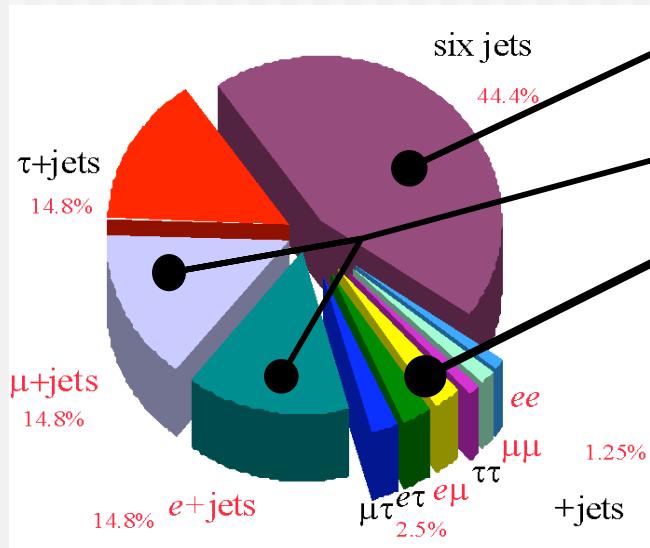
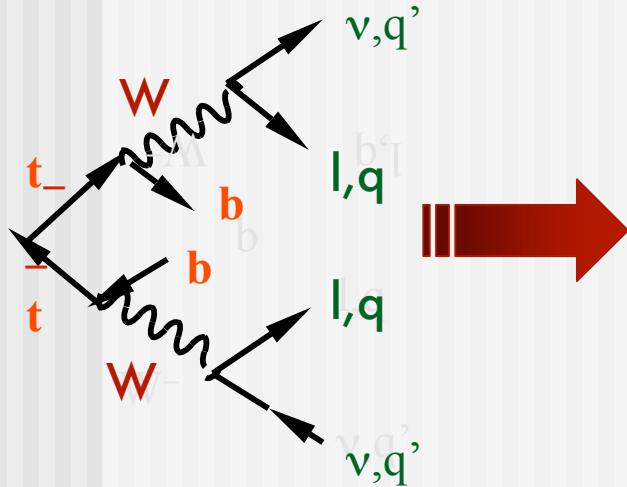
- NEED TO CONVINCINGLY FIND TOP WITH UNDERSTOOD BACKGROUNDS
- THEN CAN MEASURE IT'S MASS AND OTHER PROPERTIES

PRODUCTION AND SIGNATURES

$$\sigma(t\bar{t}) = \frac{N_{obs} - N_{bkg}}{A \int L dt}$$

- Even though the top mass is high, pair production wins over single top because it occurs strongly: 85% qqbar, 15% gluon fusion @ LO
 - Theoretical cross section @ 1.8 TeV = 5.2 pb
@ 1.96 TeV = 6.7 pb +/- 0.42 pb
 - Expect a 30% cross-section increase

M. Cacciari et al. JHEP 0404:068 (2004)
N. Kidonakis and R. Vogt, Phys. Rev. D 68 114014 (2003)
- Final states dictated by W decays:



All-jets
 (background: QCD)
Single lepton
 (background: W+jets, QCD)
Dilepton
 (background: Z/g, WW,
 W+jets)

Keep track of $\tau \rightarrow e, \mu$

LEPTON+TRACK - CDF

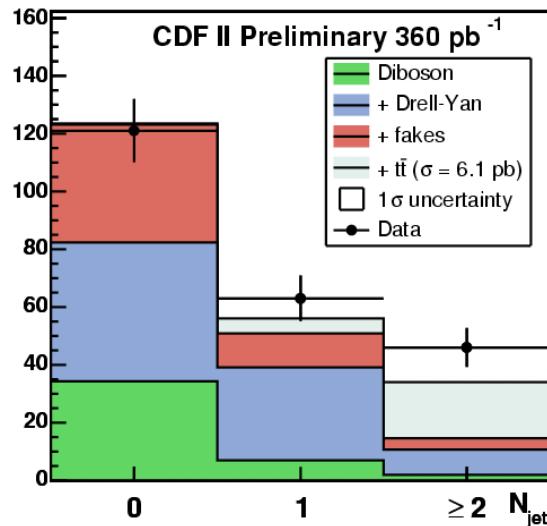
$m_t = 178 \text{ GeV}$

- Avoid full inefficiency of lepton identification
- In 360 pb^{-1}
 - 46 observed, 14.6 ± 3.6 background

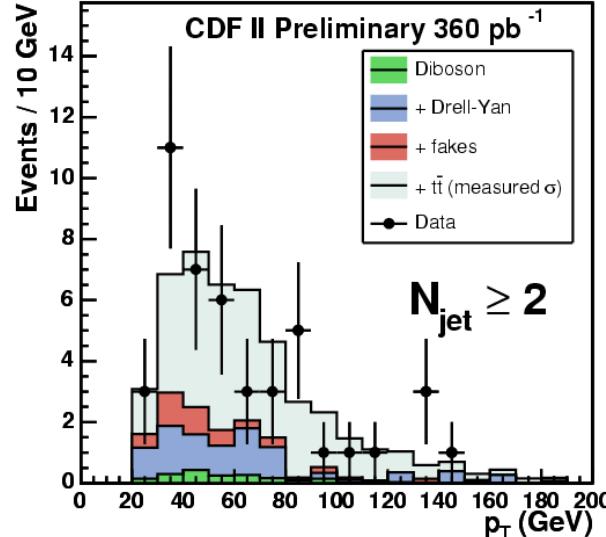
1 lepton, 1 track
2 jets
 E_{miss}

$$\sigma_{tt} = 9.9 \pm 2.1(\text{stat}) \pm 1.3(\text{syst}) \pm 0.6(\text{lum}) \text{ pb}$$

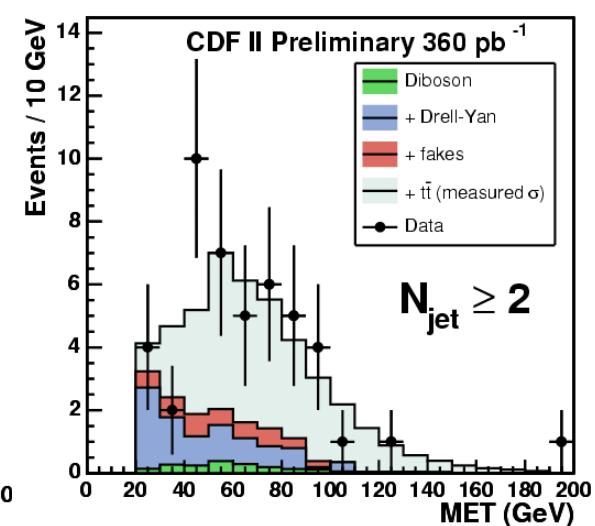
Event count per jet bin



Leading Lepton Transverse Momentum



Missing Transverse Energy



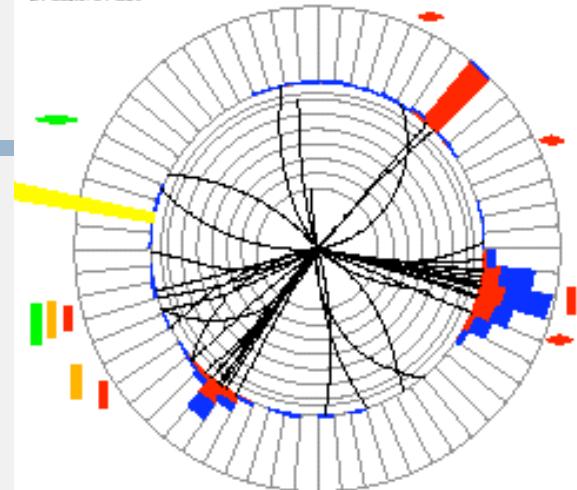
$m_t = 175 \text{ GeV}$

DILEPTON - DØ

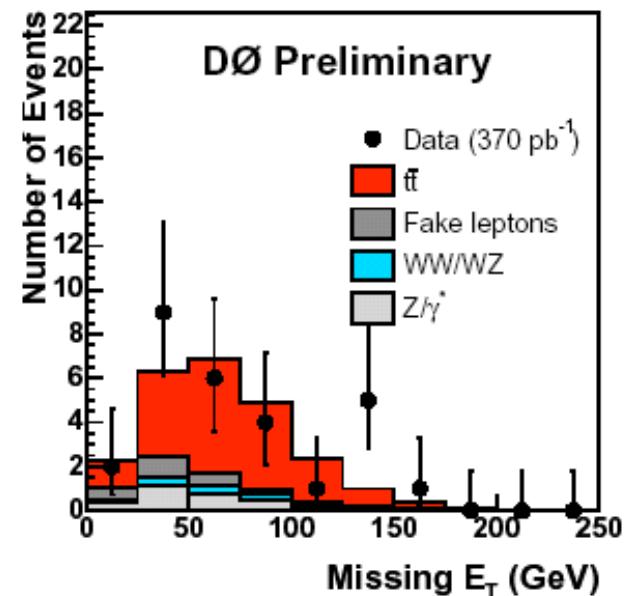
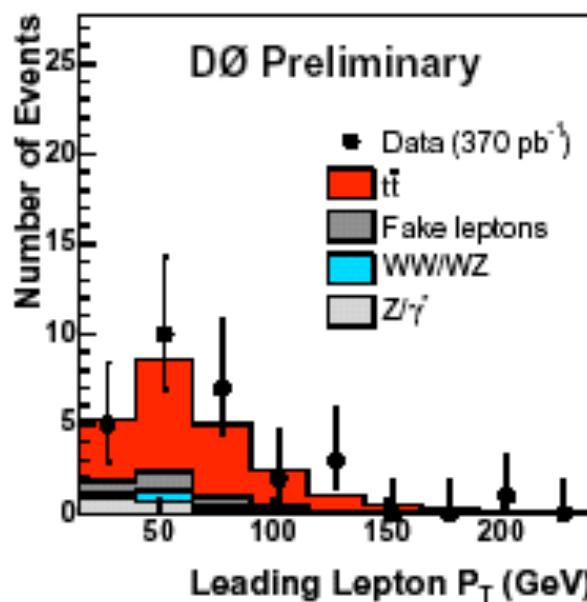
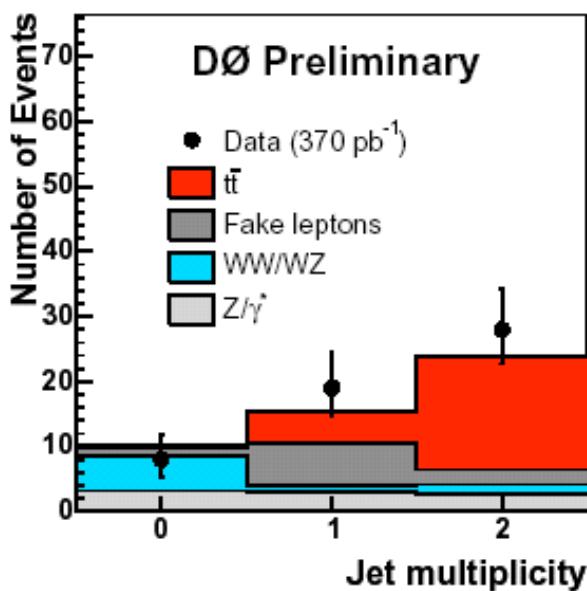
2 leptons
2 jets
 E_{miss} , High pT

Run 193332 Evt 3472458 Tue Jan 25 15:58:40 2005

ET scale: 54 GeV

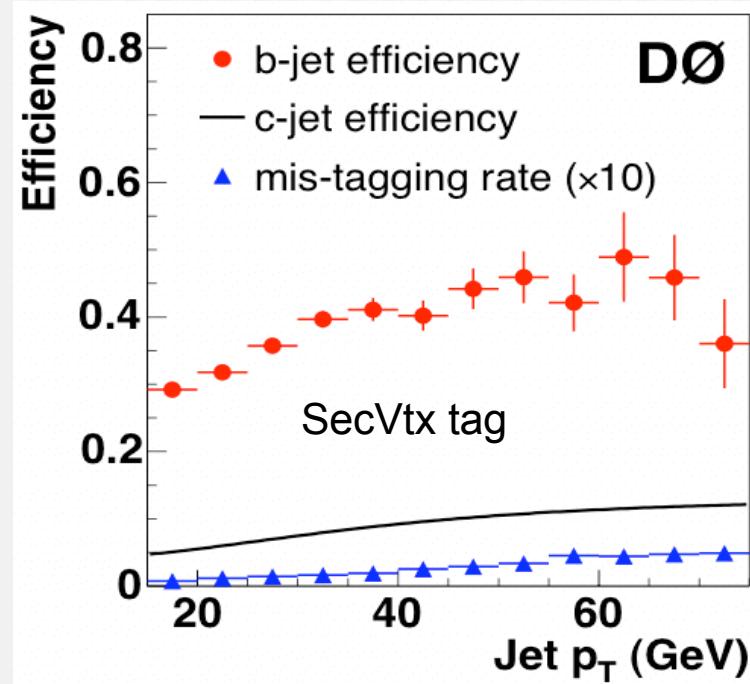
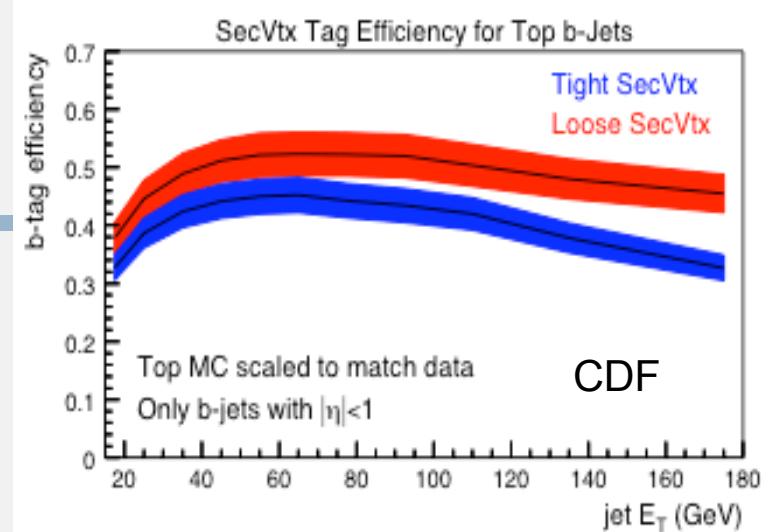


- Kinematics-based selection
- 13 evts, background 3.2 ± 0.7
 $\sigma_{tt} = 8.6^{+3.2}_{-2.7} (\text{stat}) \pm 1.1 (\text{sys}) \pm 0.6 \text{ pb}$ (230 pb^{-1} PLB)
- 28 evts, background $6.8 + 2.6 - 1.8$
 $\sigma_{tt} = 8.6^{+2.3}_{-2.0} (\text{stat})^{+1.2}_{-1.0} (\text{sys}) \pm 0.6 \text{ pb}$ (370 pb^{-1} prelim.)



b-TAGGING

- Secondary vertex tagging
 - Find primary vertex for event
 - Reconstruct vertex from tracks in jet
 - Select jets with positive tags
 - based on decay length significance
 - CDF has new tagger, more efficient
- Jet probability tagging
 - Know track resolutions
 - Calculate probability that tracks in jet originate from event primary vertex
 - Select jets with low probability



SINGLE LEPTON - DØ

1 lepton

3 or 4 jets

E_{miss}

$m_t = 175 \text{ GeV}$

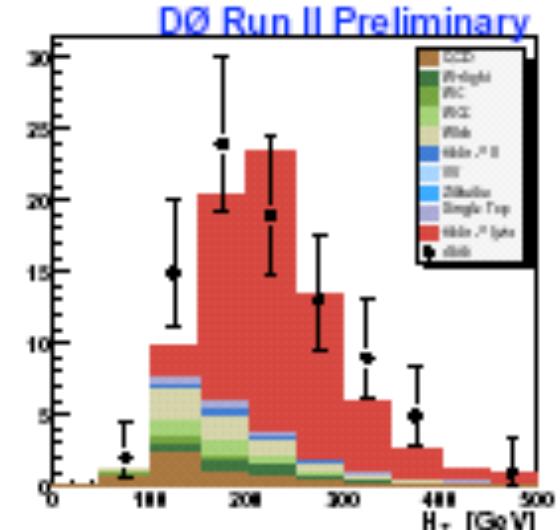
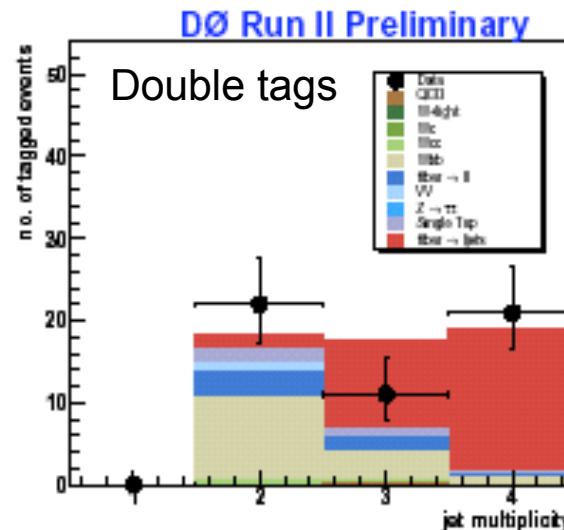
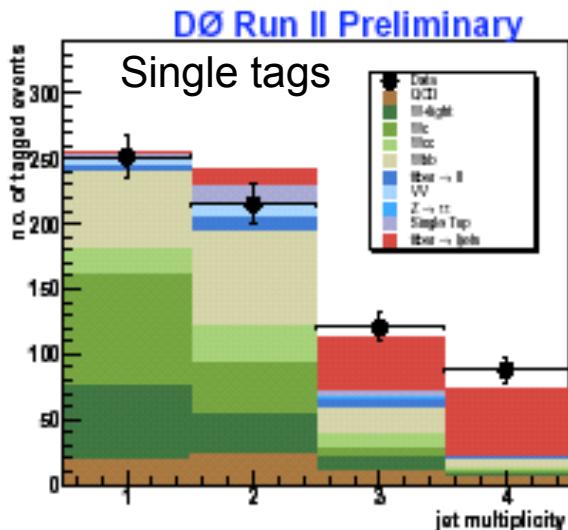
■ In 230 pb^{-1}

$$\sigma_{tt} = 6.7^{+1.4}_{-1.3}(\text{stat})^{+1.6}_{-1.1}(\text{sys}) \pm 0.4(\text{lum}) \text{ pb} \text{ (PLB, topo.)}$$

$$\sigma_{tt} = 8.6^{+1.6}_{-1.5}(\text{stat + sys}) \pm 0.6(\text{lum}) \text{ pb} \text{ (PLB, b-tag)}$$

■ 370 pb-1 (prelim.)

$$\sigma_{tt} = 8.1^{+1.3}_{-1.2}(\text{stat + sys}) \pm 0.5(\text{lum}) \text{ pb} \text{ (prelim, b-tag)}$$



$m_t = 178 \text{ GeV}$

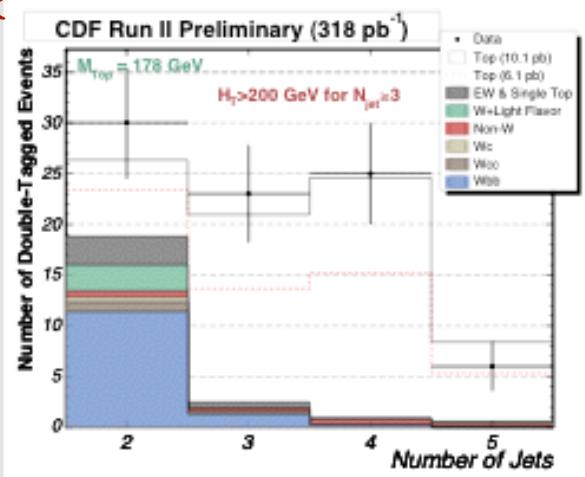
$\blacksquare 318 \text{ pb}^{-1}$

SINGLE LEPTON - CDF

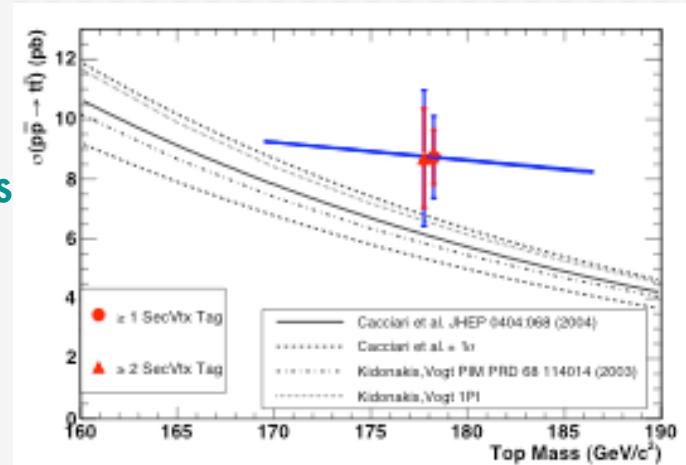
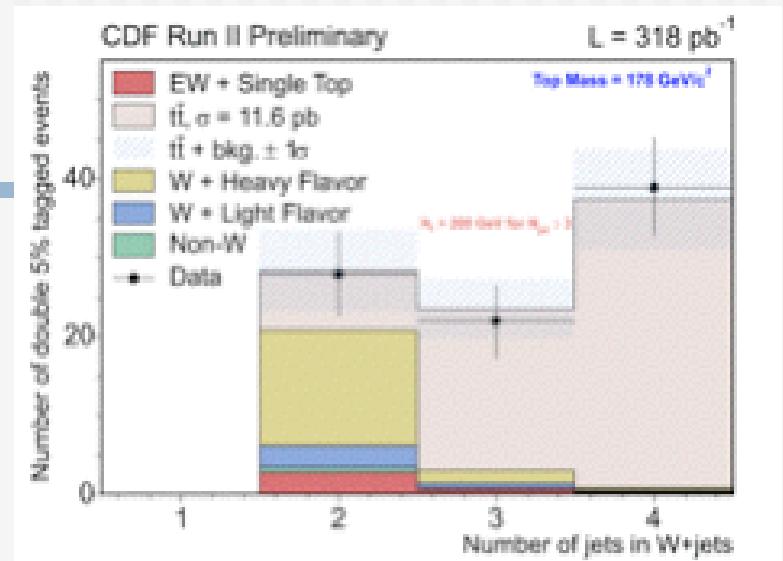
- jet probability tag
 - Look at single, double tags
 - $P_{\text{jet}} < 1\%, 5\%$
 - Very consistent results
 - More top needed

$$\sigma_{tt} = 8.9 \pm 1.0(\text{stat}) \pm 1.1(\text{sys}) \text{ pb} \text{ (prelim, jet prob.)}$$

- SecVtx tag $\sigma_{tt} = 8.9 \pm 0.9(\text{stat})^{+1.2}_{-0.9}(\text{sys}) \text{ pb} \text{ (prelim, sec. vtx.)}$



- Two taggers
- Compatible results



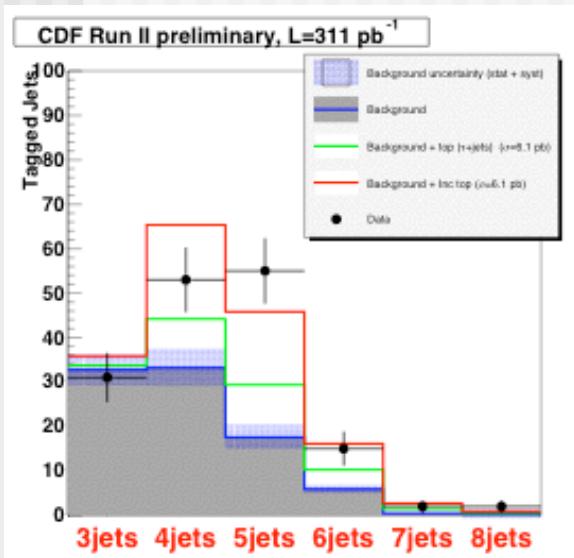
MULTI-JETS

- No required leptons, need to tag b-jets
- All-jets

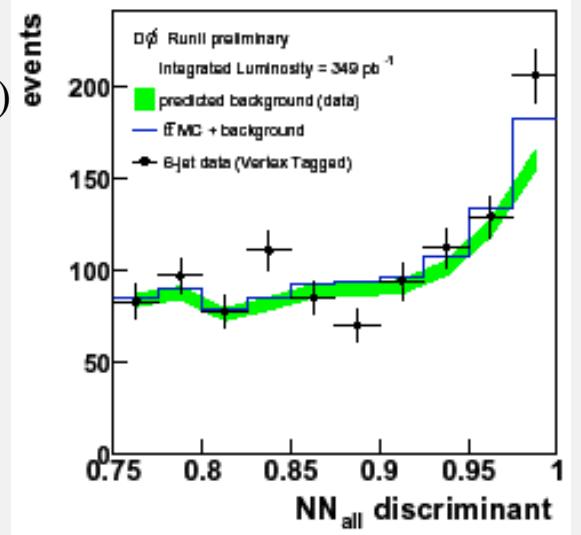
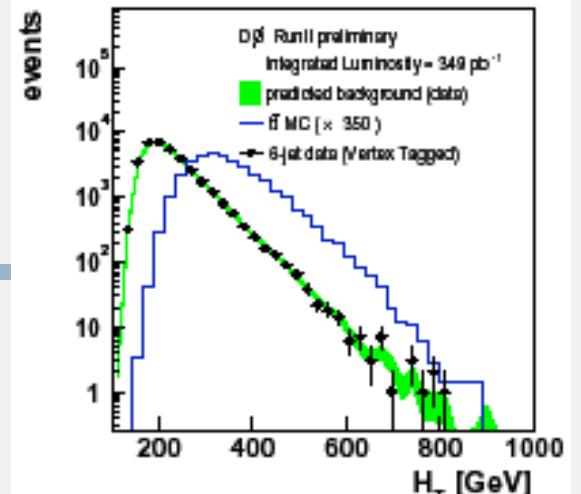
$$\sigma_{tt} = 7.5^{+3.7}_{-2.8} (stat + sys) \text{ pb (CDF prelim, } 311 \text{ pb}^{-1})$$

$$\sigma_{tt} = 5.2^{+2.6}_{-2.5} (stat)^{+1.5}_{-1.0} (sys) \pm 0.3 (lum) \text{ pb (D0 prelim, } 350 \text{ pb}^{-1})$$

- $\text{MET} + \text{jets}$



enhance $W \rightarrow \tau\nu$



$$\sigma_{tt} = 5.9^{+1.8}_{-1.6} (stat + sys) \text{ pb (CDF prelim, } 311 \text{ pb}^{-1})$$

BREAKDOWN OF UNCERTAINTIES

- Systematic uncertainties

- beginning to dominate lepton+jets
- Significant fraction of dilepton, multijet channel results

	D0 dilepton	D0 l+jets/ 2nd vtx	CDF l+jets/ 2nd vtx	CDF l+jets/ jet prob tag
Tagging	—	0.4 pb	5.2%	7.2%
Lepton ID/ isolation	0.4 pb	—	5.0%	4.9%
Jet energy scale	0.5 pb	0.2 pb	4.3%	4.2%
Background model	—	0.4 pb	4.4%	—
Jet ID/ reconstruction	+0.5 - 0.4 pb	0.2 pb	—	—
triggering	+0.7 - 0.4 pb	0.3 pb	—	—

SUMMARY RESULTS

- Have gone from $\sim 200 \text{ pb}^{-1}$ to almost 400 pb^{-1} in current analyses

